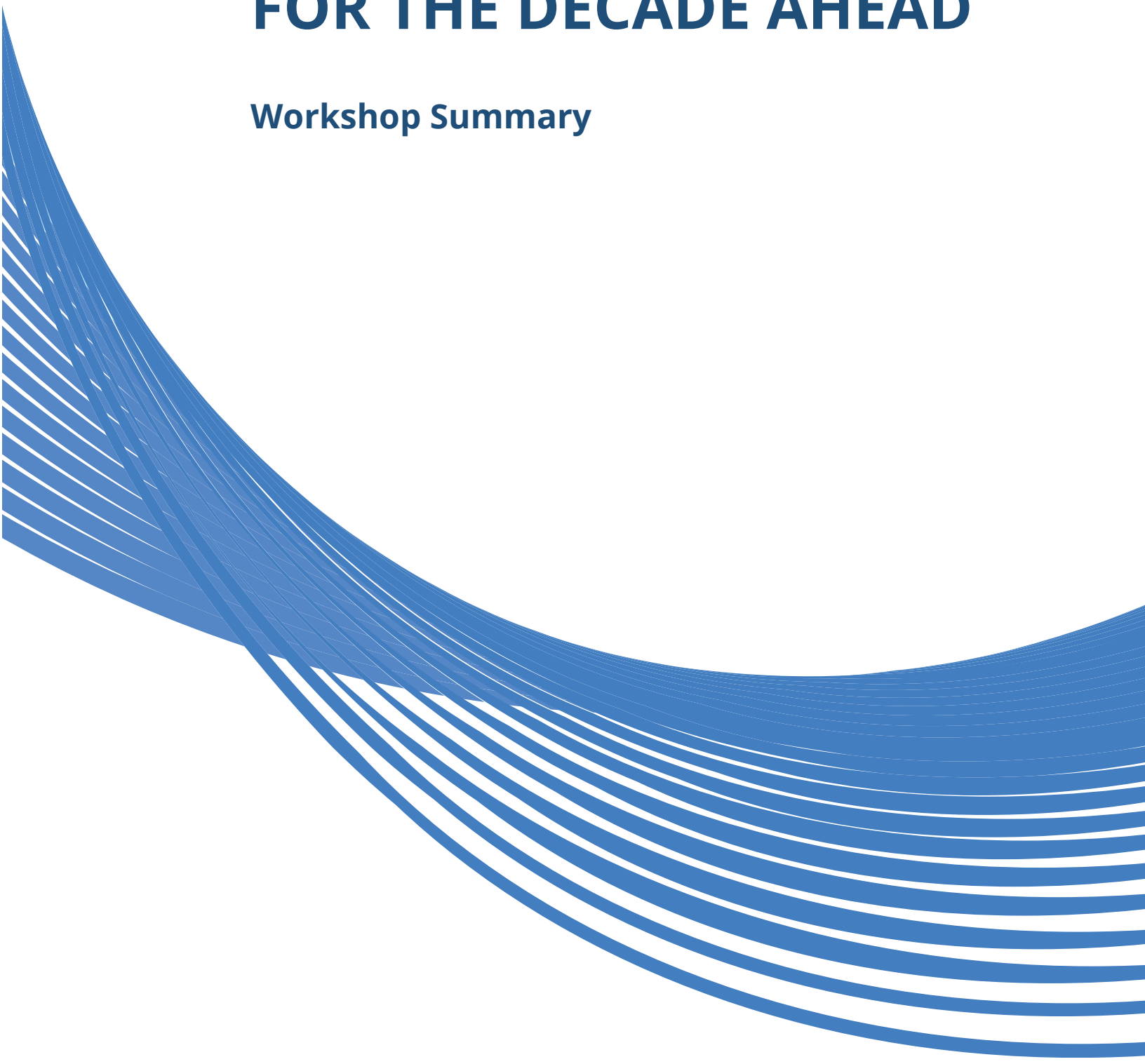
RETHINKING U.S. BIOSECURITY STRATEGY FOR THE DECADE AHEAD

Workshop Summary



Center for Global Security Research
LAWRENCE LIVERMORE NATIONAL LABORATORY

Workshop Summary

RETHINKING U.S. BIOSECURITY STRATEGY FOR THE DECADE AHEAD

Center for Global Security Research
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The Center for Global Security Research (CGSR) at Lawrence Livermore National Laboratory (LLNL) hosted a workshop titled, "Rethinking U.S. Biosecurity Strategy for the Decade Ahead" on October 27-29, 2020. The workshop included participants from the policy, military, and technical communities in the United States as well as from U.S. allies. The workshop, convened virtually due to the ongoing global COVID-19 pandemic, was a close collaboration between CGSR and the Physical Life Sciences (PLS) Directorate at LLNL. While the scope of conference extended beyond current circumstances to include precedents and predictions for both public health and bioweapons, contemporary events weighed heavily on the discussion participants.

Discussion was guided by the following key questions:

- What lessons should be drawn from the COVID-19 crisis for the future of U.S. biosecurity strategy?
- What bio-related threats, risks, and dangers must be accounted for in the decade ahead?
- How can the coherence of national and international responses be improved?

Key take-aways:

1. Past crises, biological and otherwise, generated numerous lessons which have been observed but not learned. Disinformation campaigns such as those seen during the COVID-19 pandemic are a major part of any public health emergency, resulting in instability, distrust, and ultimately resistance to public health measures that attempt to slow the spread of a virus. Future public health responses will need to be proactive and adaptive to boost public trust, as misinformation can be just as viral and evolving as the biological virus itself.

2. Biological threats are inherently difficult to calibrate. In the natural environment, emerging and re-emerging pathogens are constantly evolving and spread opportunistically. The

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intentions and capabilities of human actors to exploit biological agents for purposes of terrorism and war are also in flux as advancing biotechnologies enable both state and non-state actors to develop new threats. Thus, bio surprise is inevitable, even when the risk is generally acknowledged. Following the initial surprise, rapid detection and assessment are critical to staying ahead of the threat.

   a. Looking ahead a decade, emerging infectious diseases will likely intensify. A combination of factors, including increased human encroachment into remote habitats and the effects of global warming, can be expected to increase the frequency of epidemics and pandemics. Participants agreed that the United States does not have the luxury of preparing for one or the other (naturally-occurring or man-made); it must be prepared for both.
   b. Early warning can make a huge difference in mitigating human and other consequences. This requires broad surveillance, reliable information, and broad information sharing. The United States and the international community have multiple capabilities in place to look for early warning signs of an emerging public health crisis, but these depend on a high degree of scientific competence and credibility. Both have diminished in recent years or have failed to adapt in the face of growing political and societal challenges to authority and expertise. Divestment, disinformation, and outright attacks have all been contributing factors.
   c. With early indicators in hand, the role of the scientific community is to out-race the unfolding public health crisis by rapidly characterizing the biological source, openly sharing epidemiological data, implementing public health measures (such as mask-wearing, contact tracing, and isolating the sick), and developing medical therapeutics. The ability to do these has greatly advanced in recent years, with improved international cooperation within the scientific community a contributing factor. The potential pathways to medical solutions have also increased significantly (e.g., there are currently 44 vaccines for COVID-19 in clinical evaluation and another 154 in pre-clinical stages).

3. Looking to the future, specific actions should be in place to enable an effective crisis response. This includes steps to enable the rapid production and deployment of diagnostic tests, monoclonal antibodies, antivirals, and anti-inflammatory drugs. It also includes steps to maintain a capacity for large-scale development and production of vaccines and new therapeutic drugs. In addition, better predictive models would improve the analysis of alternative interventions; however, these models require access to well curated and prepositioned data sets. A key challenge in accelerating responses by the medical research community is the improved use of research that has not yet been peer reviewed; some innovative mechanisms to rapidly review, assess, and make available worthy research are now up and running.

4. In addition, many of the global and regional partnerships needed to respond effectively have not worked as desired during COVID-19 and are in need of repair. These partnerships include the following: public-private, public health-national security, medical-law enforcement, U.S.-allies, international organizations-member states, government-news media, elements of the supply chain, etc.

5. To a significant extent, further revisions to national strategy will be driven by lessons learned from the COVID-19 epidemic. As the pandemic tapers off, governmental attention and funding are likely to remain high—for a while. If the past is any guide, however, other demands will emerge, and both attention and funding will decline. Given the expectation of an increased frequency of public health crises in the future, specific actions should be taken now while there is increased funding and public attention on the problem.
    a. Successful management of a health crisis requires a whole of government response. Essential capabilities include the ability to rapidly get all stakeholders to the table, generate reliable data, quickly define required decisions and make them, rapidly identify and cope with unexpected facets of the problem, coordinate the distribution of limited resources, and coordinate implementation activities across state, federal, and local lines. They also include the ability to manage the domestic and international political dimensions of a situation, rather than try to pretend that a public health crisis is not a political event. The opportunity to learn and practice these skills will improve their efficacy during a crisis.
    b. Communicating effectively in crisis is an especially important skill. Past crises have repeatedly taught a lesson about the importance of communicating with empathy. This means telling the truth, providing hope, setting expectations, and being explicit about "the ask" of the audience.
    c. Much more can be done both nationally and internationally to strengthen existing capacities and add new capabilities. Significant gaps remain in the global architecture of institutions and processes for managing biological risks, whether naturally occurring or man-made.
    d. The United States should also learn from the successes of its COVID-19 response, particularly those from Operation Warp speed. Many panelists commented that the speed by which vaccine candidates have advanced to clinical trials was amazing. This success story demonstrates how the U.S. government can help underwrite cost and risk of new vaccine development for pharmaceutical companies.

6. Excellence in life sciences is central to effective management of bio-risks, but the social sciences and the humanities have something to contribute as well. Important contributions from these disciplines include their ability to identify key social and political factors necessary for implementing effective public health measures and elucidate the intentions of adversaries' pursuit of biological technologies and to help improve understanding of the social, economic, and political consequences of public health phenomena. Education in the life sciences should reflect the need for technical expertise that is broadly cognizant of the utility of other relevant disciplines

Panel 1: The Challenge of Anticipating Emerging Threats

- What methodologies and toolkits were used to characterize pandemic risk? Can they be improved? How?
- What preparations are appropriate for Black Swan events?
- Do we have adequate means to "connect the dots" between information source divided between public health and national security domains?

The prevailing approach to managing pandemic risks is to quickly detect and respond to infectious diseases as they arise. The tools for doing so have steadily improved since the 1980s. Panelists cited two in particular: first, in the mid-1990s, U.S. and Israeli support developed the Global Infectious Disease and Epidemiology Network, a unified online software platform for diagnosing diseases and identifying potential treatments. With the twin advent of genomic science and improved computing power, U.S. universities and federally funded research centers developed significant bioinformatics capabilities to aid in the processing of emergent pandemic data and the identification of responses. The widespread use of relatively inexpensive, high throughput genomic sequencing has aided bioinformatics efforts and may aid in characterizing the risks of future pandemics. The genomes of over 2000 viruses have been sequenced thus far, although approximately 300,000 mammalian viruses remain unsequenced.

In contrast, success in predicting the emergence of harmful pathogens has proved more elusive. A stronger worldwide surveillance system that monitors people with novel and unusual diseases would provide additional early warning before pandemics emerge. However, there are domestic and geopolitical barriers to the development of such a surveillance system. Governments are hesitant to provide external researchers with the kind of access necessary to conduct good disease surveillance, while sustained access might require a degree of international cooperation that is unrealistic in an era of renewed interstate competition. In addition, all pathogens are somewhat unique, and the emergence of a particularly virulent infectious diseases can overwhelm the ability of public and private sector actors to prevent spread of a contagion and rapidly produce vaccines and treatments. These challenges affect both man-made and natural pathogens. Man-made threats are further complicated by the dual-uses of many emerging biotechnologies which lack effective means for establishing norms to enforce their misuse.

Early warning and response could also be significantly improved with a better understanding of which pathogens might infect humans and cause adverse effects. This could contribute to efforts to anticipate natural pathogens as well as potential man-made threats. A framework for understanding the movement of pathogens from animal to human hosts would involve several aspects, including identifying whether animals and humans share particular cell receptors that would allow for infection, the intracellular components that would allow viruses to replicate, and the mechanism of cross-species transmission. Panelists also identified the importance of studying single- and double-stranded RNA and DNA viruses to better understand their replication. The U.S. government through DARPA and other funding has sponsored several efforts to develop tools for anticipating future pandemics. Nevertheless, such efforts must contend with the unique attributes of otherwise related pathogens. For instance, SARS-CoV-2, the novel coronavirus that causes COVID-19, proved to be more infectious and more harmful than other coronaviruses.

Nevertheless, panelists emphasized that it was too costly an effort to study all identified viruses to understand potential risks. A more fruitful approach was to invest in better global biosurveillance to filter out "signals" from "noise"—that is, to leverage the capabilities of the global health community to provide credible early warning when potential pathogens first begin to spread. While there is national interest in anticipating emerging threats, participants did not identify a clear path forward for U.S. government efforts. One recommendation was that the U.S. Intelligence Community reassess its standards for confidence when making judgments about potential pandemic risks. Excessively high confidence requirements for community acceptance of judgments could, the argument goes, limit further study of a potential threat. Another recommendation was to leverage artificial intelligence and computing capabilities to better mine large data sources for insight into emergent threats.

Panelists emphasized, however, that future pandemics are better understood as "grey rhinos" rather than "black swans." That is, rather than being extremely rare and "out of left field" events, pandemics overall are likely to be a consistent feature of the landscape; marked by detectable signatures and indicators; and merit significant investments in preparation and response. Indeed, both the George W. Bush and Barack Obama administrations issued recommendations on bio-surveillance strategy, including on strategies for facilitating information flow between different elements of the U.S. government and between government and private/academic sector entities.

Previous administrations have made some progress in facilitating the processing and use of information from different sources, particularly from within different entities of the U.S. government. The Intelligence Reform and Prevention Act adopted in the aftermath of the September 11 and domestic anthrax attacks allowed for better coordination across the intelligence and law enforcement communities. More remains to be done, particularly in terms of assessing the credibility of different information sources. Social science and humanities could make a potentially significant contribution in this area, providing anthropological and deep qualitative information to facilitate the sharing of information and clear messaging.

Panel 2: The Challenge of Responding to an Emergent Threat

- In the local and national level responses, what should and could have been done differently?
- In the international responses, what could and should have been done differently?
- In global perspective, who got it right? How did they do so?

Discussion of the U.S. response to COVID-19 centered on the two related problems of threat model and jurisdiction. Participants noted that federal agencies are more prepared for discrete threats like hurricanes or CBRN (chemical, biological, radiological, and nuclear) attacks than a long-term pandemic.

Pandemics also differ from discrete disasters in requiring a long-term response. Participants agreed that even now we do not know when this pandemic will end. Some participants argued

for the framing of gradual recovery rather than reopening and noted that much of the burden of recovery falls on Congress and local governments rather than disaster response agencies, which do not have mechanisms for pandemic relief. Government agencies such as the Department of Defense that had this capacity were sidelined during the COVID-19 response. In the absence of clear federal leadership, many states felt pressures to implement their own strategies, leading to messaging confusion and reduced effectiveness.

Participants agreed that the U.S. government did not identify and elevate a single focal authority for its response, whether at the White House or a federal agency. This lack of a central authority led to confusion and mistrust over information emanating from various sources, especially as guidance changed over time. Other failures that plagued the U.S. response included a slow or nonexistent national response, politicization of health agencies and their advice, skepticism of expertise, and confusion over relative responsibilities of different levels of government.

Several participants noted that regardless of jurisdiction, the problem of sustainable public health response will persist. Policy and funding tend to focus on the threats of the day but invariably drops off after a year or two. However, much of the infrastructure necessary for the next epidemic can be predicted and will require sustained federal funding—for example, a national contact tracing capacity.

Internationally, the effectiveness of national responses defied traditional public health readiness metrics like the Joint External Evaluation and Global Health Security Index. These standards essentially represented proxies for wealth, yet their relationship to COVID-19 outcomes was more or less random. Participants highlighted other factors that seemed to predict strong national responses instead, including trust in government, elder care at home, past experience with SARS and MERS outbreaks, and routine mask-wearing. For example, South Korea possesses all these characteristics and quickly controlled COVID-19, despite similarities to the United States in economic development, population size, and timing of its first COVID-19 case. Regime type did not seem predictive of response, either—one participant pointed out the contrast in response even between U.S. states.

Participants also discussed the role of the WHO, but largely agreed that most of its shortcomings were inherent to its role as a global public health organization and would persist in any alternative. All countries want effective multilateral public health governance but are reluctant to fund and empower the WHO or accept its criticism. Participants pointed out that the WHO already offers effective guidance, but like all multilateral organizations cannot compel obedience from its members. Participants also discussed how rising geopolitical competition between China and the United States hurt multilateral public health cooperation: the United States withdrew from the WHO and refused to participate in any forum that did not affirm that COVID-19 first occurred in China, and China blocked discussion of COVID-19 in the United Nations Security Council.

Panel 3: Biological Warfare 2030

- What countries are violating the ban on biological weapons? With what known activities? What might technological developments make possible for them?
- What are the prospects for bioterrorism? Biocrime?
- Can biodefense keep up?

This panel examined the impact of the COVID-19 pandemic on state and non-state perceptions of the utility of biological weapons. The 2020 U.S. State Department Adherence to and Compliance with Arms Control report identified four countries as potentially in violation of the Biological Weapons Convention (BWC): China, Iran, North Korea, and Russia. These states are suspected of conducting offensive biological weapons research and development. Conventional wisdom suggests that while COVID-19 demonstrated the catastrophic consequences of a pandemic, it also created disincentives for states to develop pathogens as offensive biological weapons. Although China and North Korea have fared better than their adversaries during the pandemic, they have still been affected. States are unlikely to pursue the weaponization of a novel pathogen because of the potential for blowback. Panelists stressed the importance of avoiding a biosecurity dilemma in the coming decade, or the misinterpretation of other countries' defensive research. A boost in biotechnology investment is likely as countries emerge from the pandemic, and dual-use research can create insecurity between states.

The panelists determined that the COVID-19 pandemic will not fundamentally alter the calculations of non-state actors in pursuing bioterrorism capabilities. The bioterrorism ambitions of non-state actors are often conflated with those of state actors, despite the latter having better resources for advances in science and technology. Because there are cheaper and more accessible ways to cause violence, most terrorist groups will not pursue biological weapons development. Additionally, using biological weapons would also run the risk of alienating their supporters. Jihadists and far-right extremists have primarily used the pandemic for propaganda purposes, such as discrediting their enemies and increased recruitment. The main terrorist groups that states should be concerned about are those with apocalyptic ideologies, such as the Islamic State.

A strong public health system creates the opportunity for deterrence by denial against biological attack or bioterrorism. If a public health system is strong enough that a biological attack would be mitigated, adversaries may be deterred from using biological weapons. Between now and 2030, the panelists expect a huge investment in medical countermeasures. This is beneficial for both aspects of a cohesive biodefense strategy, for preparedness response and recovery.

Regarding biodefense, participants emphasized that the inability to mitigate efficiently the COVID-19 pandemic in the U.S. was not due to a failure of imagination. The pandemic demonstrated clear structural vulnerabilities across the U.S. health care system, perhaps inadvertently exposed an "Achilles heel" that future bioweapons could target. Insufficient data, in large part due to uncertainties caused by an emerging virus, led to an inability to predict the evolution of the pandemic, specifically the emergence of hotspots in some locations and not others. Personal protective equipment (PPE) was distributed quickly, but inherent vulnerabilities in the U.S. supply chain are evident, most notably the reliance on foreign suppliers. That the

mobilization of the Department of Defense was integral to the U.S. response highlights the need for adequate resources and streamlined coordination of the Department of Health and Human Services. The pandemic also indicated a separation between force health protection and chemical/biological weapons defense at the Department of Defense. These strategies need to be consolidated. Additionally, the continued modernization of manufacturing and supply chain capabilities during peacetime should be a key focus of U.S. biodefense efforts during the next decade.

Central to the conversation on biodefense was the danger of misinformation and disinformation in public health crises. The disinformation campaigns perpetuated throughout the COVID-19 pandemic should be expected during any future biological weapons attack or disease outbreak. Disinformation directly affects the public by causing instability, blocking resilience, and creating the conditions to allow a virus to spread more easily. As a tool that could affect messaging surrounding other weapons of mass destruction (WMD), the panelists discussed the need for integration of WMD and disinformation analysts at the federal level.
Panelists also highlighted the importance of responsible public messaging and transparency surrounding biodefense research. While there is always a possibility of threat inflation by discussing the risks of dual-use research, the panelists believe it is a key responsibility of the scientific community. The promotion of safe and secure research minimizes the downside that might emerge from an open discussion on non-pathogenic biological effects, such as those from advanced technologies like CRISPR-Cas9. The U.S. focus on select agents should be broadened to reflect this understanding.

The COVID-19 pandemic shows that international biodefense should also be strengthened. Strong coordination between the United States and its allies and partners is critical for mitigating biological outbreaks. Although COVID-19 is not a biological weapon, member states of the BWC could use the treaty as a forum to coordinate better international biodefense efforts. States could also look to the Global Health Security Initiative, created in the wake of 9/11, to enhance coordination. Overall, the panelists concluded that the United States has an opportunity over the next decade to shape the perception of its vulnerability to biological attacks.

Panel 4: Public Health Risks 2030

- Over the coming decade, are public health crises likely to become more or less frequent? Why?
- Can public health responses reduce their expected impact?

Participants agreed that pandemics and epidemics are likely to become more frequent in the coming decade and beyond. Habitat destruction, factory farming, and global warming are all growing, increasing human-animal interactions and facilitating transmission of animal viruses to humans. The mobility of humans and animals is also increasing, allowing diseases to have greater reach. Lastly, growing nationalism and the atrophy of multilateral intuitions impedes effective global cooperation in responding to epidemics and pandemics.

While predicting the origin and pathology of future epidemics is impossible, participants underscored that the underlying facts making them likely are well-known. Any virus with more than one host, including a mammal, has an increased chance of finding a foothold in humans. In particular, it is certain that we will experience additional influenza epidemics or pandemics: all the necessary genes for human invasion and spread are already circulating in animal hosts. Certain species, such as those brought into close contact with humans through farming or species that can harbor mammalian viruses in particular, warrant additional biosurveillance. Participants expressed similar certainty that the fundamentals of public health responses, especially for the respiratory viruses most likely to cause pandemics, are well-known. Regardless of the specific virus, we know that basic universal public health measures like masks and handwashing will slow its spread. We also know that we can treat symptoms without a vaccine and are improving point-of-care symptom relief.

Nonetheless, both proactive and reactive elements of public health responses can be improved to better deal with the next pandemic. Participants discussed the potential for improving virus discovery systems: while there is likely a low-level "chatter" of viruses jumping from animals to humans, we have much to learn about why that occurs and could benefit from advanced warning and sequencing of new viruses with epidemic potential.

Discussion of proactive responses broadened to include addressing factors often left out of public health. Meat consumption, deforestation, and climate change all make pandemics more likely. Poverty, malnutrition, and unequal access to healthcare worsen their impact. Several participants emphasized that effective public health begins before the outbreak of disease. In terms of reactive public health measures, participants discussed several lessons from COVID-19. One common theme was the need for a better testing regime. Here, discussion once again touched on the tension in the U.S. system between individual responsibility for clinical healthcare and government responsibility for public health. Another lesson is the need for government to provide space for people to quarantine and isolate, since congregate living leads to infection. Lastly, government can prepare for the next pandemic by stockpiling resources, arranging reserve manufacturing capacity for tests and vaccines, and using the Defense Production Act or other strategies to offset surging demand of resources that cannot be stockpiled. However, many participants expressed the opinion that these were uncontroversial remedies well before the COVID-19 pandemic, and that much of the shortcomings in the U.S. response came from a failure to implement preexisting advice or policy.

This led to a discussion on how public health experts can better make the case for these policies to the government and the public. Some participants noted that acquiring funding for pandemic response is difficult under the traditional annual budget model, since pandemics are not a predictable annual expense. A different financing mechanism like insurance might therefore be more apt. Participants also pointed out that public health experts are criticized heavily for either overreacting or underreacting if a pandemic does not materialize or is worse than anticipated, making proactive efforts difficult.

Participants also reflected on the relationship between academia and government. Many argued that public health academics should eschew a focus on pure research in favor of building

relationships with government needs, despite such approaches not being directly rewarded in academia.
A final element of the discussion turned to boosting public trust in public health. Multiple participants compared misinformation to a disease in its virality and constant mutation, and argued for permanent, well-funded mechanisms to disseminate advice and build trust. Participants also called for the depoliticization of health agencies involved in pandemic response. The problems of rebuilding trust in government and extinguishing misinformation are key examples of roles social scientists can play in public health policy.

Panel 5: Balancing Pandemic Preparedness and Biodefense

- How should that balance be struck?
- How much preparedness is enough? Why?

Regardless of source, government responses to a rapidly spreading infectious disease are likely to draw on common resources and capabilities. Therefore, there are both synergies and tradeoffs with respect to biodefense and pandemic preparedness at the Federal Government level. An effective response to both natural and man-made threats requires similar capabilities to monitor a pathogen's spread, understand its short-and long-term effects, coordinate and disseminate resources at multiple levels of government, and so forth. A similar set of capabilities might also be brought to bear to identify emerging threats.

Tradeoffs are most likely to arise at the level of federal situational awareness: panelists stressed that the threat—man-made and naturally occurring—remains high, but the pathways through which man-made versus natural threats might arise are different and may require different surveillance approaches. For natural threats, global biosurveillance networks should work to provide advance warning of pathogens that could become pandemics. In contrast, anticipating man-made threats may require a more complex understanding of dual use and emerging disruptive technologies. Panelists stressed that the diversity of threats, as well as the complexity of mounting a nationwide response, are likely to require the U.S. government to adopt a more decentralized—but nonetheless coordinated—approach to pandemic preparedness and biothreat response. Such an approach would involve several elements.

First, panelists stressed such a decentralized approach would require the participation of both public and private sector and civil society actors at the federal, state and local levels. While the Federal Government can play a central role in coordinating resources, funding new programs, and strategy, other partners will necessarily have to assume some responsibilities. For example, panelists argued that local-level experts, such as public health experts in universities, could assume greater responsibility for public communications, countering misinformation and promulgating public health guidance in the local area. This is an opportunity to establish frameworks for clear messaging at the local level, because many people trust information from community over national or international sources.

Second, panelists stressed that a decentralized approach nonetheless requires coordination at all levels of government. In other words, decentralization does not mean a lack of coordination.

Panelists drew on the example of the U.S. approach to responding to natural disasters, such as hurricanes. Since Hurricane Katrina in 2005, the Federal Government made significant strides in its strategy for disaster response as embodied in the National Response Framework (NRF). The NRF explicitly highlights the participation of state and local organizations and actors, stressing that "the larger or more complex the incident, the greater the number and variety of organizations that must respond." Balancing preparedness and biodefense will require decentralized execution and a division of labor while still ensuring overall Federal direction.

Third, striking the right balance requires greater commitment to both biodefense and pandemic preparedness at federal, state, and local levels. Panelists once again contrasted the U.S. response to the COVID-19 pandemic with the federal response to severe weather events of increasing frequency. The United States has faced infectious disease threats in the past, yet there is no comparable commitment or framework for responding to pandemics compared to that for hurricanes.

Fourth, there is cross-over between public health medical infrastructure and pandemic response. Better support of basic healthcare response and public health can be foundational to response during crisis. Military medicine can also provide additional resources. Coordinating investment between military medicine and public health can lead to additional resources with which to response to a public health emergency.

According to panelists, the relative absence of a federal commitment to both pandemic preparedness and biodefense somewhat diminishes concern that the United States might overprepare in the aftermath of the coronavirus pandemic. Nevertheless, panelists stressed that identifying "how much is enough" requires the development of a standards with which to measure progress. This too requires more attention to the overarching issues of leadership, collaboration, cooperation, and communication. The United States has made progress in pandemic response, particularly since the Ebola outbreak, but it has much further to go.
In addition, panelists stressed the need for improved after-action assessments to identify and disseminate lessons learned from previous pandemic responses. "Midcourse" or "Intra-action" assessments could also enable federal responses to improve in real time. Both require greater resources to allow personnel to collect and analyze data.

Panel 6: Balancing Oversight and Execution

- What is the proper and necessary role of scientific expertise?
- How much and what kind of oversight is necessary for effective policy execution?

Leading in biotechnology is crucial for many U.S. economic and strategic goals; however, the U.S. must balance these with necessary regulation and oversight. Geopolitical events, such as global pandemics or great power competition, can also influence this balancing act. How can leaders strike the right balance to attain maximal benefit and prosperity for the United States? It was also clear that professionals in the biological sciences should play a role in determining this balance, potentially through organizations such as the National Academies that bridge the scientific and policy communities.

Responsible leadership is a central factor in establishing the necessary oversight starting at labs and extending to the intergovernmental sphere. Biotechnology and biosecurity regimes call for principled leadership that is responsive to scientists, policymakers, and stakeholders across institutions. Engaged leaders devise whole of enterprise solutions, an issue noticeably lacking with COVID-19 and a theme which will certainly appear in the future.

Accordingly, oversight from knowledgeable leaders is a vital force in crafting policy that will spur innovation to build trust across sectors. Leaders and bureaucrats setting the regulatory tone should be mindful of striking the right balance: scientists who labor under burdensome regulatory regimes may be stymied in their pursuit of technological advancement. Leaders should avoid counterproductive measures such as layers of oversight, redundant paperwork, or a distrustful culture that hinder scientists' spirit of risk taking or engagement beyond a stove-piped world. One troubling reality exists: much of global oversight falls between seams of multinational organizations, and cooperation from scientists and policymakers is essential to remedy a dilemma brought further into relief by COVID-19.

There is no ambiguity on the necessary role of scientific expertise in biosecurity and biotechnology: to leverage cooperation to play an outsized role in working beyond the sphere of geopolitical competition. Panelists were unanimous in scientists' power to work effectively across borders, to make friends via science. Forging relationships based on like-minded scientific expertise creates the possibility for the scientific community to harmonize interests that may sit uneasily between sparring nations' heads of state. A basis for a Track 2 or 1.5 dialogue between different governments may run through the long-standing friendships that were cultivated by scientists before the return of great power competition. Scientist-to-scientist bonds offer policymakers with a foundation to utilize not only for diplomatic ends, but also in the possibility of a future global pandemic that necessitates collaboration. Scientific relationships will be the cornerstone for future cooperation, even when the fires of geopolitical competition flare up.

Biotechnological competition with China represents a rupture from the past and threatens American primacy in this domain. Chinese policymakers identified biotechnology as a key space for China to dominate. China's prioritization of biotechnology meets multiple ends for a state poised to shape geopolitics: Chinese biosecurity, the nation's economy, and the health of the Chinese people. China's strategic whole of nation investment in biotechnology aims to unseat the United States from its place of historic control over the material and intellectual production of biotechnology. In a break from historic competitors, a rival nation-state is pouring resources into technology development at levels that are comparable with the United States' public-private funding streams.

With the arrival of a near peer competitor in biotechnology, how should U.S. policymakers strike the right policy balance? On the one hand, stakeholders in government, philanthropy, and the private sector cannot underestimate the magnitude of the challenge. The implications for the United States extend beyond facing a competitor. China's military-civil fusion, alongside torrents of state funding, aspires to fuse agents across China into the mission of overtaking America's global position. The stakes are clear, and the consequences of losing preeminence for American biosecurity and economy should not be underestimated.

On the other hand, engagement with Chinese scientists and policymakers should not be dismissed out of hand. The experts agreed that China should be encouraged to take up a partnership role in the global biosecurity and biotechnology architecture. Evidence of Chinese willingness to participate exist at the institutional and personal level, and the voices on both sides of the Pacific urging cooperation should not be squelched. An American whole of enterprise solution to compete with China can exist in parallel with outreach efforts to prevent future pandemics. Striking the right balance between engaging and competing with China will not be easily executed, yet it is a policy solution that leaders in Beijing and Washington must embrace.

A whole of sector push to facilitate developing nations' biotechnology and biosecurity development can garner influence for the United States. Developed countries no longer hold a monopoly over biotechnologies. Developing countries are increasing investments in biotechnology, and this represents an opportunity for the United States to assert global leadership. Leveraging the United States' scientific expertise to compete against China, shape norms, and usher in a global regulatory regime is not only a positive series of outcomes. It gestures to a policy agenda for the America's role in the world's biotechnology and biosecurity frontier.

Nation-state competition is not the only challenge facing the United States. A pattern of panic and neglect historically led policymakers and the public to abandon investments in biosecurity of the order required to overcome COVID-19 and future pandemics. Institutions that preserve focus on biosecurity and biotechnology must be built that strike the right balance between encouraging oversight, elevating scientific expertise, competing with China, and cooperating internationally. The United States' security, health, and economy are tethered to a biotechnological future that demands attention, not neglect.

Panel 7: Conclusions and Implications

It is unlikely that we will be able to predict where or when the next pandemic will occur. Many of the most dangerous pandemics are caused by viruses that jump from animal hosts to humans. While advances in biotechnology allow us to sequence entire virus genomes much faster, broad efforts to sequence emerging viruses in animals before they jump to humans funding challenges by the U.S. government.

Even if these efforts are funded, there is still a gap between broad virus surveillance efforts, many of which do not lead to pandemics, and providing actionable warning and intelligence for the U.S. government. As a result, we should expect a degree of surprise and uncertainty in the face of an emerging pandemic. Preparing for pandemics or public health emergencies, whether naturally occurring or man-made, before they occur remains a challenge. Several factors, such as population growth and climate change, increase the likelihood of pandemic-level global health events in the future.

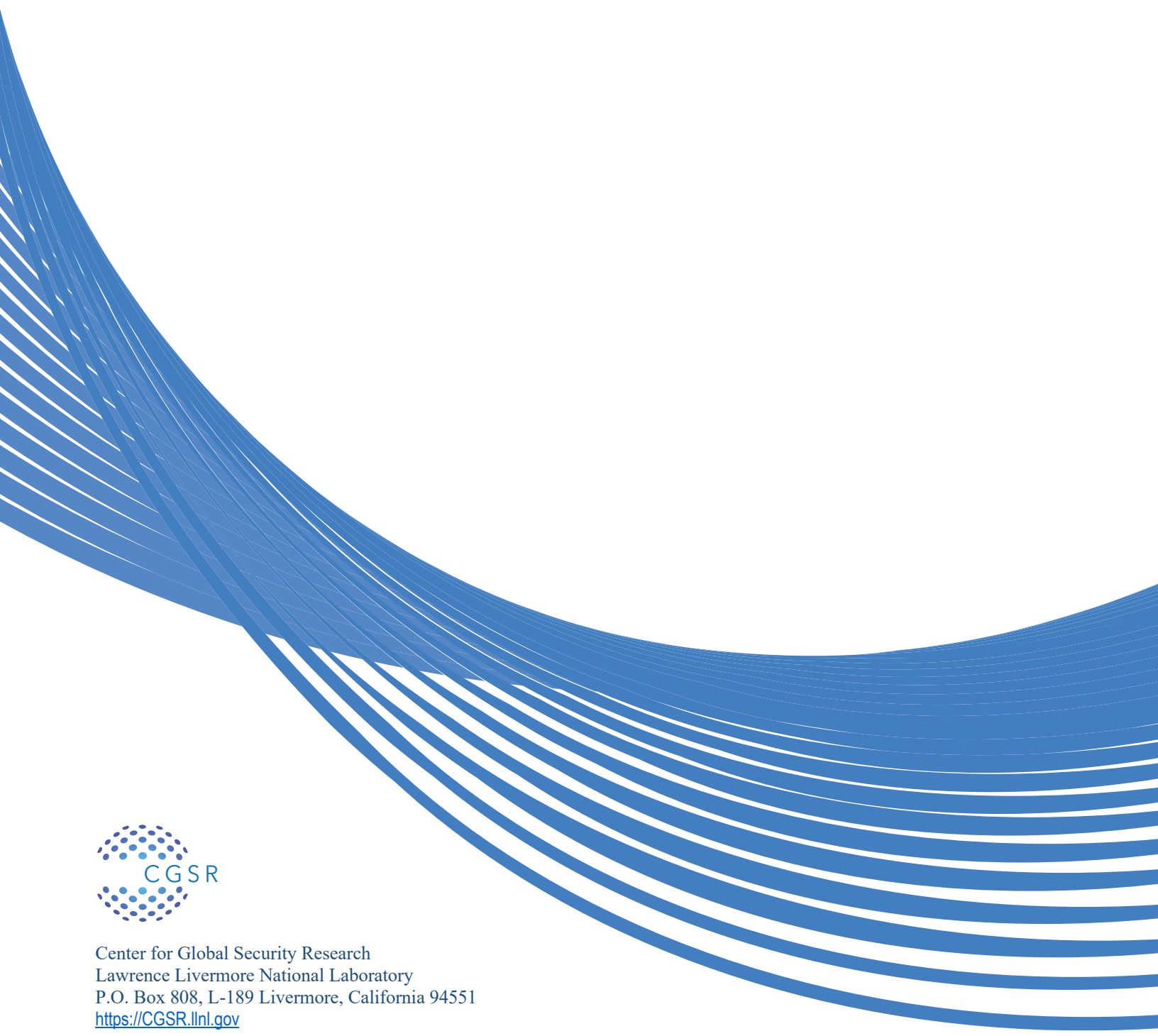
Federal leadership plays a leading role in addressing and mitigating the threat as soon as possible; however, state and local governments will also play a decentralized role in messaging and local measures. All levels of government should prepare to take on these responsibilities and collaborate effectively.

Pandemic response relies on medical supply chain management. The COVID-19 pandemic revealed the need to stockpile diagnostic supplies, such as polymerase chain reaction (PCR) reagents. Shortages in these and other diagnostic supplies led to a reduced testing capability; a lack of widespread testing reduced the ability of public health officials to slow the transmission of the virus. Beyond diagnostic supplies, stockpiling common antiviral treatments, such as corticosteroids or monoclonal antibodies, that are often used to treat symptoms before a new vaccine can be developed. COVID-19 has revealed the challenges in developing a vaccine platform from scratch, so it is likely that other treatments will be necessary in the interim.

Many of these challenges are exacerbated at the international level. While mechanisms and multilateral institutions exist, participation is not mandatory and other geopolitical factors such as great power competition hinder equal cooperation and transparency from all partners. These realities impede global data sharing and policy implementation during global public health emergencies.

Similarly, on a national level, politicization and disinformation complicate effective government response. The uncertainty that surrounds many public health emergencies is fertile ground for seeding many of these problems, particularly in an information climate that is openly antagonistic to expertise and politics. Efforts to streamline communications and manage information presented to the public are important in combatting this, especially when they involve experts in public health. For example, several scientific professional societies have launched portals to provide context on pre-print articles, which are uploaded by researchers before they are peer-reviewed.

In light of the barriers to effective communication revealed by COVID-19, it is important to consider the insights of social sciences and humanities to biosecurity policy. More could be done to expose those trained in biology to these perspectives, either as part of academic degrees or professional training. More cross-disciplinary efforts are needed.



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